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Publication Title:

Wellheads :casing cutting and removal assembly

Abstract:

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An assembly allowing the cutting and removing of tubular casing at a (e.g. subsea) wellhead comprises a swivel 20 to rotatably support the assembly from the wellhead. Hydraulic pressure pivots cutters 36 outwards; so that rotation of the assembly cuts through one or more casing(s); and also forces out arms 44 and 48 whose rollers 46, 50 stabilise the rotating cutting operating. Fluid flows through a piston until a drop-in insert creates back-pressure to shift the piston to move gripping surfaces of spear 26 outwards to grip casing, when the cut casing is lifted. The assembly allows cutting and removal of casing in one trip. A seal puller 22 may be incorporated.

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(54) Abstract Title
Wellheads :casing cutting and removal assembly

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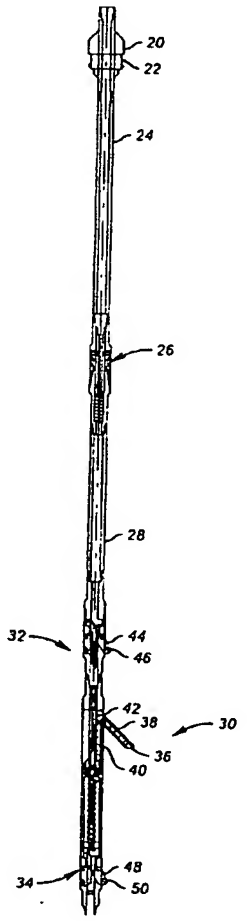

FIG. 2

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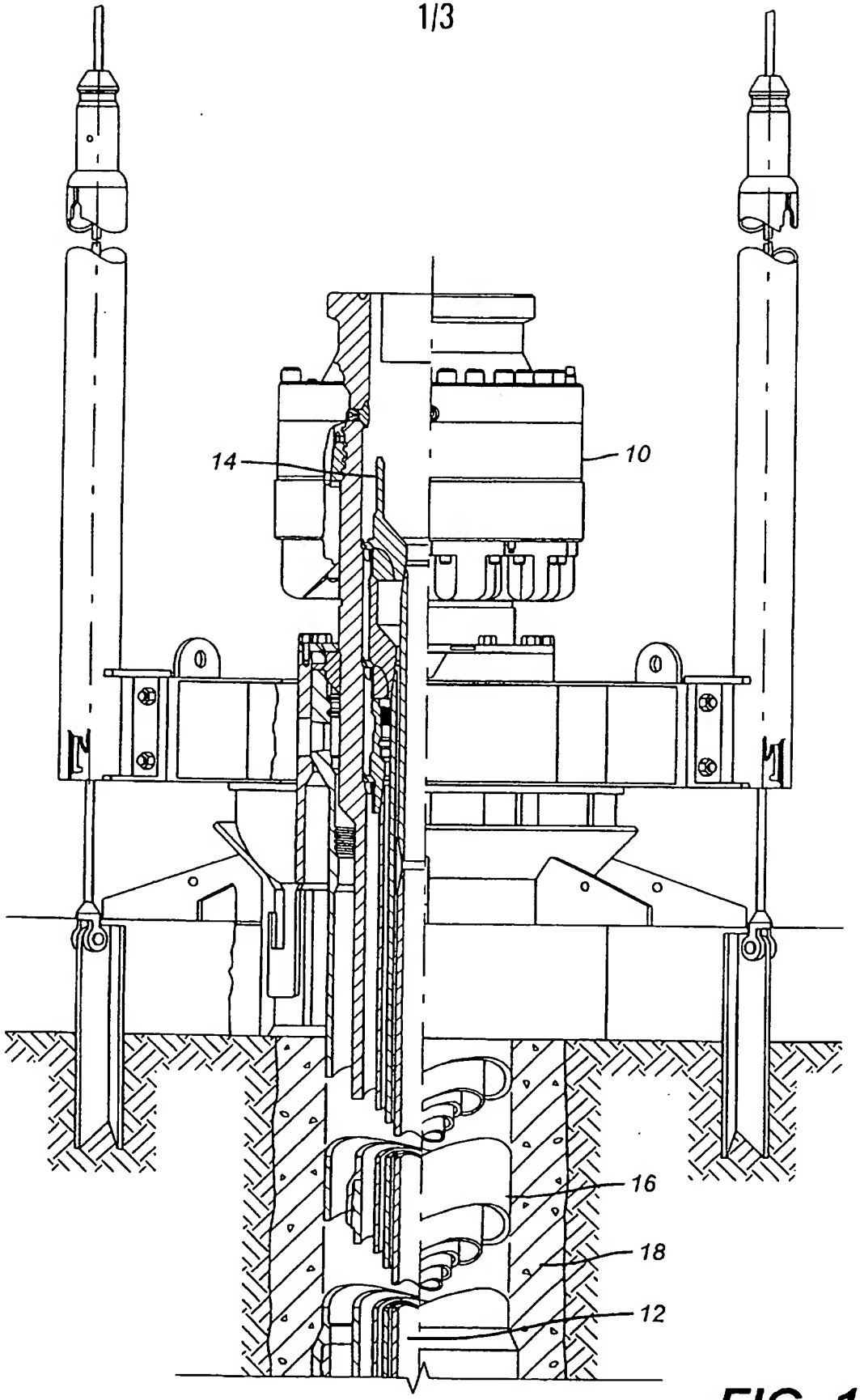

FIG. 1

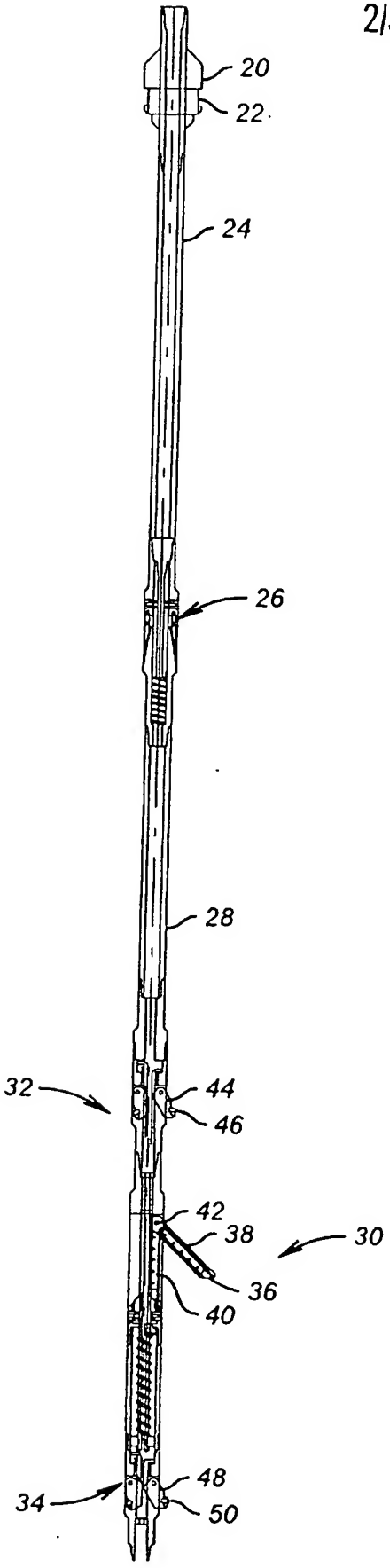

FIG. 2

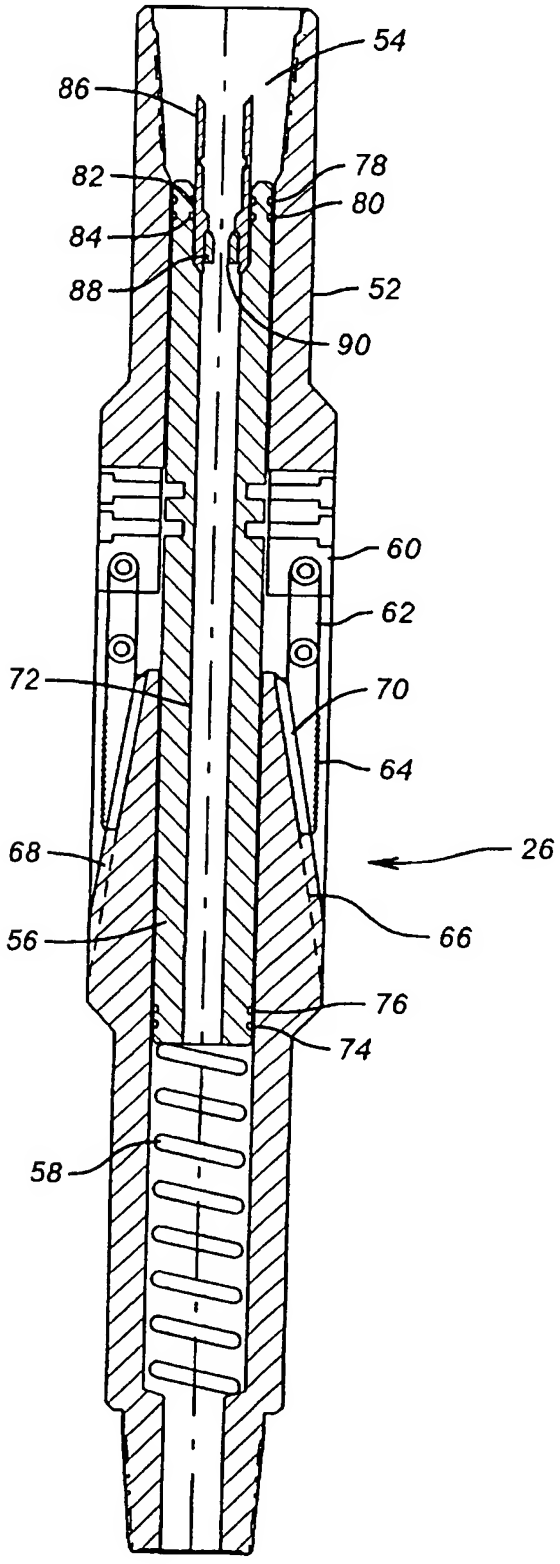

FIG. 3

One-Trip Casing Cutting & Removal Apparatus

FIELD OF THE INVENTION

The field of this invention relates to techniques for cutting and removing casing in a single trip, particularly through subsea wellheads.

BACKGROUND OF THE INVENTION

Typical completions involve multiple casing sizes concentrically mounted and supported in a wellhead, with each section having a seal assembly in the wellhead. Government regulations require removal of wellheads when the well is no longer in service. Procedures for accomplishing the removal of the wellhead would involve an initial trip to cut the innermost section of casing using a marine swivel which is supported by the wellhead. The marine swivel allows the string with a cutter to rotate while the exterior of the swivel remains stationary so that it can be supported by the wellhead. At the conclusion of this step with the innermost section of casing cut, the

cutter is removed and the seal puller is installed. It is run into the wellbore for a second trip to pull the seal for the innermost casing. Thereafter, a third trip is made with a spear to grab the cut casing segment and bring it up out of the well to the surface. This procedure can be repeated to then remove the next casing section that is exposed. Each time the seal puller needs to be a different size to accommodate the specific casing section being removed. In the event all the casing sections are to be cut, the removal of the seals for each casing size is not necessary since they will all be removed together.

There are several known spear designs on the market, such as those now produced by Baker Oil Tools and referred to as type B, C, D or E. These designs have exposed grapples so that if they are rotated, they will tend to come out radially. Accordingly, such known prior designs of spears could not be combined with a single- or multiple-string cutter because they would snag in the casing as the cutter tried to rotate.

Designs of marine swivels are also known. One such product is made by Baker Oil Tools and identified as product No. 170-01. These marine swivels can be adapted to support a seal-pulling assembly of different sizes to accommodate the sequential removal of casing sections from the wellbore in discrete 3-trip operations in the prior art.

The limitations of some of the spears of the prior art also included a weight-set feature which would make them sling out with

the application of centrifugal force. This, again, would detract from their use in conjunction with any kind of cutter involving rotation.

Accordingly, the objects of the invention are to reduce rig time, thus saving the well owner significant quantities of money by making in one trip what has previously been done in the prior art in three trips. Another object of the invention is to combine in one string a cutter of whatever type, a spear of whatever type, and seal puller of whatever type so that in one trip with these components properly spaced out, the casing section or sections can be cut, the seal assembly pulled, and the casing section grappled for removal. Another object of the invention is to improve the cutting technique with an improved actuation system for a multiple string cutter which involves longitudinal piston movement moving the cutter in an arcuate motion outwardly for the cut. Another objective is to provide wear surfaces on the cutter elements so that they can be redressed for reuse. Another objective is to provide improved stabilizers which are hydraulically actuated in the preferred embodiment to improve the cutting speed and precision. Yet another objective of the present invention is to design the spear so that the gripping members or slips are protected and cannot engage the casing as the cutter is rotated.

These objectives of the present invention will become more readily apparent to those skilled in the art from a review of the preferred embodiment described below.

SUMMARY OF THE INVENTION

A one-trip system for removing casing from a wellhead is described. The string includes a cutting device spaced at the required depth and a grappling device above it at the appropriate location. A swivel tool, such as a marine swivel, is used in conjunction with a seal-pulling assembly so that after cutting the casing, the seal assembly can be pulled without an additional trip into the well. The grappling device or spear can be hydraulically actuated to grab the casing for removal from the wellbore. The spear features a drop-in restrictor which allows sufficient flow during cutting operations with a mechanical cutter without actuating the spear, while at the same time allowing actuation of the spear by circulation after dropping in the restrictor after the casing section has been cut.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional elevation of a typical wellhead installation, showing multiple concentrically mounted casing strings.

Figure 2 is a sectional elevational view of the one-trip assembly used for cutting and removal of casing sections from the wellhead.

Figure 3 is a detailed view of the spear of the preferred embodiment, shown in sectional elevation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 illustrates a typical known wellhead assembly, showing a subsea wellhead **10**. Figure 1 further illustrates the concentrically mounted casing string starting with casing string **12**, which is the smallest. A seal assembly **14** secures the casing string **12** in the wellhead **10**. The other strings are similarly situated, with their own seal assemblies. In Figure 1, the outermost section of casing **16** is cemented with cement **18**. In between some of the other casing strings can be cemented as well. Figure 2 illustrates the assembly used for one-trip removal of one or more strings, as illustrated in Figure 1. The first string to be removed from the assembly in Figure 1 is casing string **12**. The assembly to do this in one trip is shown in Figure 2.

The assembly comprises a marine swivel **20** of known construction. Optionally attachable to it is a seal puller **22**. Both the marine swivel **20** and the seal puller **22** are known designs. Below the seal puller **22** is a section of tubing **24** to properly space out the spear **26**. The spear **26** is shown in more detail in Figure 3. Below the spear **26** is another section of tubing **28** to properly space out the cutter **30**. The cutter **30** has a stabilizer **32** above and **34** below.

In the preferred embodiment shown in Figure 2, the cutter **30** has multiple blades, one of which **36** is shown in Figure 2. The blades can have renewable cutting surfaces **38**. A piston **40**, which is hydraulically actuated,

engages the blades **36** and forces them to rotate about their respective pivot pins **42**. Hydraulic pressure also forces out arms **44** on stabilizer **32**. Each of the arms **44** has a roller **46** to engage the casing while the entire string rotates with respect to the marine swivel **20**.

The lower stabilizer **34** is built the same as the upper stabilizer **32** and operates by hydraulic actuation to move out arms **48** until their rollers **50** engage the casing.

The operation of the spear is illustrated in Figure 3. It has a body **52** and a bore **54**. A piston **56** acts against a spring **58** within bore **54**. Attached to the piston **56** is a sleeve **60** to which are attached slips **62**, each of which has a gripping surface **64**. Body **52** has a tapered conical segment **66** which has opposed grooves **68** which are for the purpose of retaining tabs **70** on slips **62**. Thus, despite the fact that the body **52** rotates, centrifugal force will not allow the slips **62** to come out radially. The slips **62** are also protected by being held in the retracted position by virtue of their tabs **70** extending in groove **68** of the conical segment **66** of body **52**.

Piston **56** has an internal bore **72**. Normally this bore is large enough so that flow rates anticipated for use in actuating the stabilizers **32** and **34** and actuating the blades **36** will not cause the piston **56** to move downwardly against the opposing force of spring **58**. Piston **56** is sealed in bore **54** by seals **74**, **76**, **78** and **80**. Bore **72** has seals **82** and **84** adjacent seals **78** and **80** near the upper

end. A drop-in restrictor **86** has a narrow renewable sleeve **88** which has a bore **90**. With the drop-in restrictor **86** seated against seals **82** and **84**, flow then has to go through the narrow bore **90**. With sufficient flow through bore **90**, the force of spring **58** is overcome and the piston **56** is pushed downwardly, forcing the slips **62** down the conical segment **66**. This moves the gripping surfaces **64** into contact with the casing. Once the gripping surfaces **64** are in contact with the casing, further flow is no longer required to hold the casing with the spear **26**. Alternative spear designs are also within the spirit of the invention.

Accordingly, those skilled in the art can now readily see how the cutting of a casing segment supported in a wellbore can be accomplished in a single trip. The string shown in Figure 2 properly spaces out the key components which are the marine swivel **20**, the spear **26**, and the cutter **30**. The seal puller **22** is secured to the underside of the marine swivel **20**. If all of the strings are being cut and removed at the same time, the seal puller **22** can be omitted. In operation, the method of the present invention involves lowering the string shown in Figure 2 into the casing and commencing flow after the marine swivel **20** comes to rest on the wellhead. Flow actuates the piston **40** to move the blades **36** pivotally about pivots **42**. Rotation of the assembly through the marine swivel **20** allows the cutting surfaces **38** to cut through one or more casing layers. While the cutting is going on, the arms **44** and **48** extend outwardly

due to the flow through the assembly such that rollers **46** and **50** stabilize the cutting operation with the cutting surface **38**. At the conclusion of the cutting of the casing string or strings, the seal assembly **14** is grabbed by the seal puller **22** and removed. The drop-in insert **86** is inserted into sealing contact with seals **82** and **84**. Further flow then creates a backpressure sufficient to overcome the force of spring **58** to downwardly shift the piston **56**. Downward shifting of piston **56** results in outward movement of the gripping surfaces **64** on slips **62** until contact with the innermost casing string is made. An upward force on the assembly then allows removal of the cut casing string.

Those skilled in the art will appreciate that other cutting devices can be used, and the cut can be made chemically or explosively or by other known techniques. The advantage of the present invention is that what previously took three trips into the well now can be done in a single trip. The spear design **26** is unique in that it resists outward movement of the slips **62** when being rotated during the casing cutting operation with the cutter **30**. The stabilizer design is new and improved in that the arms are hydraulically actuated with a piston which longitudinally moves in response to fluid pressure or flow. The arms **44** and **48** can flex to handle imperfections or out-of-round ness in the casing being cut and to better centralize the cutter **30**.

The foregoing disclosure and description of the invention are illustrative and

explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made without departing from the spirit of the invention.

CLAIMS

1. A casing cutting and removal assembly for use with multiple tubulars in a wellhead comprising:
   a cutter selectively engageable to a tubular exposed in the wellhead,
   a grapple to grab a cut portion of the tubular for removal from the wellhead,
   a swivel to support said cutter off the wellhead while allowing it to rotate,
   at least one spacer to properly position said cutter and said grapple with respect to the tubular to be cut so that the tubular can be cut and removed in a single trip.

2. The assembly of Claim 1 further comprising:
   a seal pulling assembly.

3. The assembly of Claim 2, wherein:
   said seal pulling assembly is attached to said marine swivel.

4. The assembly of Claim 1, wherein:
   said cutter comprises at least one cutting blade which is actuable by at least one first piston.

5. The assembly of Claim 4, further comprising:
   at least one stabilizer for said cutter,
   said stabilizer comprises at least one arm movable toward the tubular by at least one second piston.

6. The assembly of Claim 5, wherein:

said first and second pistons are actuable by flow through said cutter and said stabilizer.

7. The assembly of Claim 6, further comprising:
at least two said stabilizers disposed uphole and downhole of said cutter.

8. The assembly of Claim 7, further comprising:
a flow passage through said grapple which is sufficiently large so as to not actuate a grapple piston operably secured to it when said first and second pistons are activated.

9. The assembly of Claim 8, further comprising:
an insertable restriction into said flow passage in said grapple for actuation of said grapple piston,
said grapple piston advancing at least one gripper toward the tubular.

10. The assembly of Claim 9, wherein:
said gripper is cammed by said grapple piston and further comprises tabs to resist outward movement responsive to rotation of said grapple.

11. The assembly of Claim 10, wherein:
said stabilizer comprises a plurality of arms pivotally mounted and activated by said second piston.

12. The assembly of Claim 11, wherein:
said cutter comprises a plurality of cutting blades each mounted, removably

to a cutting arm which is in turn pivotally mounted and activated by said first piston.

13. The assembly of Claim 1, further comprising:
a passage through said cutter assembly and grapple,
said cutter assembly comprising at least one cutter blade which, responsive to flow moves toward the tubular before any response by said grapple.

14. The assembly of Claim 13, wherein:
said grapple comprises a gripper which is urged by flow through said grapple to move toward the tubular,
said gripper operable after a restrictor is inserted in said grapple to apply a force to move said gripper.

15. The assembly of Claim 14, wherein:
said gripper is secured to a biased piston and is mounted adjacent a camming surface,
whereupon insertion of said restrictor, flow exerts a force on said biased piston to overcome said bias and cam said gripper along said camming surface.

16. The system of Claim 15, wherein:
said gripper is retained to said camming surface against centrifugal force due to rotation.

The Patent Office

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INVESTOR IN PEOPLE

Application No:	GB 0008111.7	**Examiner:**	G R A H A M WERRETT
Claims searched:	1-16	**Date of search:**	27 July 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): E1F.

Int Cl (Ed.7): E21B.

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2259930 A	(HOMCO) see e.g. fig. 3.	1.
X	GB 2165286 A	(DEEPWATER) see e.g. Fig. 5.	1.
X	EP 0155129 A2	(MORRIS) see e.g. p. 4, l. 21 on.	1.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.